electrostatic breakdown preventing smoothing circuit to connected to the signal line.--

R E M A R K S

A substitute specification accompanies this response. No new matter has been entered in the substitute specification.

The substitute specification and claims have been amended to make editorial changes therein, bearing in mind the criticisms in the Official Action. Marked-up copies of the original specification and claims showing the changes thereto also accompany this response.

The title and abstract have been amended to make editorial changes.

The indication that claims 3 and 5 include patentable subject matter is acknowledged with thanks. In reliance thereon, claim 5 has been amended into independent form by adding the subject matter of claim 1 thereto.

New claims 9-10 have been added that include subject matter generally similar to claim 5 and believed to be allowable. Specifically, claim 9 includes, and the prior art does not disclose, a connector having two connectable elements that connect the electrostatic breakdown preventing smoothing circuit to a signal line, where a first of these two elements has a movable member that is urged to a first position in which the capacitor is connected to ground when the two elements are not

connected to each other and a second of these two elements has a pressing member that moves the movable member to a second position in which the capacitor is not connected to ground when said two elements are connected to each other. Consideration and allowance of the new claims are respectfully requested.

Claims 1-2, 4, and 6-8 were rejected as unpatentable over GOFF et al. 6,355,991 in view of GAUTHIER 5,155,648. Reconsideration and withdrawal of the rejection are respectfully requested.

Claim 1 is directed to an apparatus that includes a connector in a signal line that bi-directionally transfers data between two devices. The apparatus includes a smoothing circuit that smoothes a signal inputted to the signal line and a switching mechanism that stops the smoothing function when the connector is connected and that restores the smoothing function when the connector is disconnected. Note that the body of claim 1 refers to "the" signal line (defined in the preamble) and thus the preamble gives life and meaning to the claim and is to be considered when evaluating patentability.

Neither reference discloses a connector in a signal line that bi-directionally transfers data between two devices. Both references are related to power lines, not signal lines. Neither reference discloses a smoothing circuit that smoothes a signal inputted to the signal line. The circuit in GAUTHIER stops a power transient by protecting a direct current electrical

power supply from disturbances that may occur when connecting or disconnecting the power supply. GAUTHIER does not smooth a signal inputted to a signal line. Since both of these features are missing from the combination of references, they would not be obvious to one of skill in the art.

Further, it is not clear how the proposed combination includes a switching mechanism that stops the smoothing function when the connector is connected and that restores the smoothing function when the connector is disconnected. The Official Action indicates that the connector is the connection between 27 and 26 in Figure 1 of GOFF et al. When this connector is disconnected, the circuit in GAUTHIER et al. would be disconnected and could not provide any function. This is contrary to the claimed switching mechanism in which the smoothing function is restored when the connector is disconnected. The Official Action also refers to the transistors in the GAUTHIER et al. circuit. Are these to be the connector? If so, what is the switching mechanism?

Accordingly, it is believed that claims 1-2, 4, and 6-8 avoid the rejection under §103.

In view of the present amendment and the foregoing remarks, it is believed that the present application has been placed in condition for allowance. Reconsideration and allowance are respectfully requested.

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Attached hereto is a marked-up version of the changes made to the specification and claims. The attached page is captioned "VERSION WITH MARKINGS TO SHOW CHANGES MADE."

Respectfully submitted,

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE CLAIMS:

Claim 5 has been amended as follows:

--5. (amended) An electrostatic breakdown prevention apparatus for an electronic apparatus which includes a connector for connecting and disconnecting, between an electronic apparatus body and an external apparatus, a signal line used for bidirectional data transfer between said electronic apparatus body and said external apparatus, comprising:

an electrostatic breakdown preventing smoothing circuit provided for the signal line on said electronic apparatus body side with respect to said connector for smoothing a signal inputted to the signal line; and

a switching mechanism provided on said connector for stopping the smoothing function of said electrostatic breakdown preventing smoothing circuit when said connector is connected, but restoring the smoothing function of said electrostatic breakdown preventing smoothing circuit when said connector is disconnected,

[An electrostatic breakdown prevention apparatus for an electronic apparatus as claimed in claim 1,]

wherein said switching mechanism includes

a movable member provided for sliding movement on a first one of connector elements of said connector for which said electrostatic breakdown preventing smoothing circuit is provided

and [including] a movable contact for being contacted with [said] a grounding line to place said grounding line into a connected state,

a biasing member for biasing said movable member in a direction in which said movable contact is brought into contact with said grounding line, and

a pressing member provided on a second one of said connector elements for fitting connection to said first connector element for moving, when said first and second connector elements are connected to each other, said movable member against a biasing force of said biasing member to bring said movable contact provided on said movable member out of contact with said grounding line.--

ELECTROSTATIC BREAKDOWN PREVENTION APPARATUS [FOR ELECTRONIC APPARATUS] WITH CONNECTOR IN A SIGNAL LINE FOR STOPPING FUNCTION OF THE APPARATUS

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to an electrostatic breakdown prevention apparatus for an electronic apparatus, and more particularly to an electrostatic breakdown apparatus suitable for use with an electronic apparatus which is used frequently outdoors or at a like place where the electronic apparatus is likely to be influenced by static electricity.

Description of the Related Art

An electronic apparatus, particularly a portable electronic apparatus that is connected to an external apparatus through a connector and bidirectionally transfers data at a high speed to or from the external apparatus using the same signal line is conventionally known.

A connector of a portable apparatus to an external apparatus includes, at signal inputting and outputting portions thereof, an electric circuit for smoothing a high voltage applied momentarily thereto to prevent a breakdown of an internal electric circuit by static electricity as a countermeasure to allow the portable apparatus to be used frequently outdoors or at a like place.

However, increase of the speed of data transfer of such portable apparatus has been and is proceeding in recent years, and such a smoothing circuit as described above makes an obstacle to high speed data transfer. Therefore, it is demanded to realize both of prevention of static electricity and high speed data transfer.

Also it is demanded to reduce the number of connection lines of a connector involved in miniaturization of a portable apparatus and to achieve bidirectional data transfer on the same line.

In order to satisfy such demands as described above, a connector has been proposed in Japanese Patent Laid-Open No. 062076/1985 wherein, when the connector is not in a [non-]connecting state, a connector terminal unit structure itself is grounded in order to prevent an electrostatic breakdown. However, when the connector is placed into a connecting state, the connector terminal unit structure is brought into a non-grounded state.

The apparatus disclosed in the prior art document mentioned above cannot be configured so as to prevent an electrostatic breakdown of a pair of apparatus connected to the opposite sides of the connector where one of the two apparatus transfers a signal bidirectionally using the same signal line of the connector.

Further, for portable apparatus, the shape of a connector unit which can be used is sometimes prescribed in specifications of an interface to be used. In this instance, the apparatus disclosed in the prior art cannot be applied.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide an electrostatic breakdown prevention apparatus which allows an electronic apparatus connected to a connector to bidirectionally transfer data at a high speed on the same signal line and prevents an electrostatic breakdown of the electronic apparatus without relying upon the structure of the connector.

In order to attain the object described above, according to the present invention, there is provided an electrostatic breakdown prevention apparatus for an electronic apparatus which includes a connector for connecting and disconnecting,

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between an electronic apparatus body and an external apparatus, a signal line used for bidirectional data transfer between the electronic apparatus body and the external apparatus, comprising an electrostatic breakdown preventing smoothing circuit provided for the signal line on the electronic apparatus body side with respect to the connector for smoothing a signal inputted to the signal line, and a switching mechanism provided on the connector for stopping the smoothing function of the electrostatic breakdown preventing smoothing circuit when the connector is connected, but restoring the smoothing function of the electrostatic breakdown preventing smoothing circuit when the connector is disconnected.

Preferably, the electrostatic breakdown preventing smoothing circuit is provided also for the signal line on the external apparatus side. In this instance, preferably the switching mechanism simultaneously switches the electrostatic breakdown preventing smoothing circuit provided on the electronic apparatus body side and the electrostatic breakdown smoothing circuit provided on the external apparatus side.

The electrostatic breakdown preventing smoothing circuit includes a resistor connected to the signal line, a grounding line connected to the signal line, and a capacitor interposed in the grounding line, and the switching mechanism may be provided for the grounding line and switches the capacitor between a grounded state and a non-grounded state.

The switching mechanism may include a movable member provided for sliding movement on a first one of connector elements of the connector for which the electrostatic breakdown preventing smoothing circuit is provided and including a movable contact for being contacted with the grounding line to place the grounding line into a connected state, a biasing member for biasing the movable member in a direction in which the movable contact is brought into contact with the grounding line, and a

pressing member provided on a second one of the connector elements for fitting with the first connector element for moving, when the first and second connector elements are connected to each other, the movable member against a biasing force of the biasing member to bring the movable contact provided on the movable member out of contact with the grounding line.

Alternatively, the switching mechanism may include a lead switch provided on a first one of connector elements of the connector for which the electrostatic breakdown preventing smoothing circuit is provided, and a magnet provided on a second one of the other connector elements for connection to a second one of the connector elements for fitting with the first connector element for rendering, when the first and second connector elements are connected to each other, the lead switch operative to connect the grounding line.

A plurality of signal lines may be provided.

The electronic apparatus may be a portable apparatus.

With the electrostatic breakdown prevention apparatus for an electronic apparatus, if static electricity enters the electronic apparatus in a state wherein an external apparatus is not connected to the electronic apparatus, then the waveform of the static electricity is smoothed, and consequently, application of a high voltage to the electronic apparatus is prevented. As a result, an otherwise possible breakdown of the electronic apparatus can be prevented.

Further, since an electronic circuit, i.e., the electrostatic breakdown preventing smoothing circuit, achieves the smoothing of the waveform of the static electricity, the electrostatic breakdown prevention apparatus can be incorporated into the electronic apparatus easily. Thus, the electrostatic breakdown prevention apparatus can be applied simply and conveniently to an electronic apparatus which performs bidirectional data transfer by means of the same signal line. Further, such incorporation

of the electronic breakdown prevention apparatus into an electronic apparatus can be performed without having an influence on the configuration of the connector which connects the apparatus, and also application to an electronic apparatus into which a connector is designed to be incorporated is easy.

The above and other objects, features and advantages of the present invention will become apparent from the following description and the appended claims, taken in conjunction with the accompanying drawings in which like parts or elements are denoted by like reference symbols.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic block diagram showing an electrostatic breakdown prevention apparatus to which the present invention is applied; and

FIG. 2 is an enlarged cross sectional and diagrammatic view showing the electrostatic breakdown prevention apparatus of FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIGS. 1 and 2, there is shown an electrostatic breakdown prevention apparatus for an electronic apparatus to which the present invention is applied. Referring first to FIG. 1, the electrostatic breakdown prevention apparatus includes a connector 3 including first and second connector elements 3a and 3b for connecting and disconnecting, between an electronic apparatus body (not shown) and an external apparatus (not shown), a signal line 2 used for bidirectional data transfer between a data transmission-reception section 1 provided on the electronic apparatus body and the external apparatus. At least on the electronic apparatus body side, the signal line 2 has an electrostatic breakdown preventing smoothing circuit 4 for smoothing a signal inputted to the signal line 2. The connector 3 includes a switching

mechanism 5 for stopping the smoothing function of the electrostatic breakdown preventing smoothing circuit 4 when the connector 3 is connected, that is, when the connector elements 3a and 3b are fitted with and connected to each other, but restoring the smoothing function of the electrostatic breakdown preventing smoothing circuit 4 when the connector 3 is disconnected.

Referring now to FIG. 2, the electrostatic breakdown preventing smoothing circuit 4 includes a resistor 6 connected to the signal line 2, a grounding line 7 for connecting the signal line 2 to the ground G, and a capacitor 8 interposed in the grounding line 7. The switching mechanism 5 is provided on the grounding line 7 and switches the capacitor 8 between a grounded state and a non-grounded state.

The switching mechanism 5 includes a movable member 9 provided for sliding movement on the first connector element 3a of the connector 3 [on] to which the electrostatic breakdown preventing smoothing circuit 4 is connected. The movable member 9 has a movable contact 9a for being contacted with the grounding line 7 to place the grounding line 7 into a connected state. A biasing member 10 biases the movable member 9a in a direction in which the movable contact 9a is brought into contact with the grounding line 7. A pressing member 11 is provided on the second connector element 3b to be fitted with the first connector element 3a and moves, when the connector elements 3a and 3b are moved toward each other so as to be connected to each other, the movable member 9 against a biasing force of the biasing member 10 to bring the movable contact 9a provided on the movable member 9 out of contact with the grounding line 7 to disconnect the grounding line 7.

The first and second connector elements 3a and 3b include connecting terminals 12 and 13 connected to the signal line 2, respectively. The first and second connecting terminals 12 and 13 are brought into contact with and electrically connected to each other when the connector elements 3a and 3b are fitted with and connected to

each other. Consequently, the electronic apparatus and the external apparatus not shown are connected to each other through the signal line 2.

The first connector element 3a has an insertion detection section 14 on which the movable member 9 is mounted for sliding movement. An insertion portion 15 is provided on the second connector element 3b, and the pressing member 14 is integrally provided on and protects from the insertion portion 15.

On the insertion detection section 14, the grounding line 7 is cut midway and the cut portions are held in a spaced relationship by a predetermined distance from each other such that they are opposed to the movable contact 9a provided on the movable member 9.

The electrostatic breakdown prevention apparatus for an electronic apparatus according to the present embodiment having such a configuration as described above is used in a state wherein the connector 3 is disconnected when the electronic apparatus by itself is used.

When the connector 3 is disconnected in this manner, since the movable member 9 of the switching mechanism 5 is acted upon by the biasing force of the biasing member 10, the movable contact 9a provided on the movable member 9 is pressed against the cut portions of the grounding line 7 to electrically connect the cut portions to each other to hold the grounding line 7 in a conducting state in which the capacitor 8 is electrically connected to the ground G.

Here, if static electricity having such a waveform as shown in (a) of FIG. 2 enters the electrostatic breakdown preventing smoothing circuit 4 through the signal line 2, then the waveform of the entering static electricity is smoothed in such a manner as shown in (b) of FIG. 2 by an action of the resistor 6 and the capacitor 8. As a result, a high voltage is prevented from being applied to the data transmission-reception

section 1 which requires protection against a high voltage. Consequently, an otherwise possible breakdown of the data transmission-reception section 1 is prevented.

On the other hand, when the electronic apparatus is to be connected to an external apparatus to transmit or receive data to or from the external apparatus, the first and second connector elements 3a and 3b are fitted with and connected to each other.

When the connector elements 3a and 3b are fitted with each other in this manner, the opposite portions of the signal line 2 with respect to the connector 3 are connected to each other through the connecting terminals 12 and 13. Further, when the connector elements 3a and 3b are moved toward and fitted with each other, the movable member 9 is moved against the biasing force of the biasing member 10 by the pressing member 11. Thereupon, the movable contact 9a of the movable member 9 is brought out of contact with the cut portions of the grounding line 7, and consequently, the conduction of the grounding line 7 is interrupted midway and the capacitor 8 is disconnected from the ground G.

In this state, if an ordinary data signal is inputted to the electrostatic breakdown preventing smoothing circuit 4, then the data signal is inputted to the data transmission-reception section 1 only through the resistor 6. Consequently, the waveform of the data signal is not smoothed. Therefore, high speed data communication is allowed.

Since entering of a high voltage into the data transmission-reception section 1 is prevented by the electrostatic breakdown preventing circuit 4 formed from an electric circuit as recognized from the present embodiment, the data transmission-reception section 1 can be incorporated readily into the electronic apparatus. Also where a plurality of such electrostatic breakdown preventing circuits 4 are provided, they can be switched simultaneously by the single switching mechanism 5.

Accordingly, the electrostatic breakdown preventing smoothing circuit 4 can be provided additionally on the second connector element 3b side. This makes it possible to apply the electrostatic breakdown prevention apparatus of the present invention also to an apparatus which need perform bidirectional high speed data transmission/reception.

Also where a plurality of such signal lines 2 as described above are provided, it is possible to provide the electrostatic breakdown preventing circuit 4 for each of the signal lines 2 so as to provide an electrostatic breakdown prevention function to each of the signal lines 2.

Also it is possible to form the switching mechanism 5 from a lead switch and a magnet for switching the lead switch on and off. Accordingly, since the switching mechanism 5 can be provided without having an influence on the structure of the connector 3, it can be applied readily also to an apparatus in which it is designed to incorporate the connector 3.

While a preferred embodiment of the present invention has been described using specific terms, such description is for illustrative purposes only, and it is to be understood that changes and variations may be made without departing from the spirit or scope of the following claims.

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